DESCRIPTION

GASKET FOR COMPRESSOR

This application is a U.S. National Phase Application under 35 USC 371 of International Application PCT/JP2003/014429 filed on November 13, 2003.

TECHNICAL FIELD

The present invention relates to a gasket used in a compressor and more specifically, it relates to a structure that achieves both an improvement in the sealability and miniaturization of the compressor.

BACKGROUND ART

A compressor used as an element constituting part of a refrigerating cycle includes a gasket so as to prevent leakage of compressed coolant through areas where the housing is connected and the like. Examples of the known art related to such gaskets include one in which ring-like beads are formed each surrounding one of the cylinders (see Japanese Unexamined Patent Publication No. H11-343974). These ring-like beads with their sections rising in a U-shape increase the force with which a gasket comes in contact with the areas around the cylinders and, as a result, leakage of the high-pressure coolant inside the cylinder to the outside can be prevented more effectively.

In addition, in another example of the related art, beads are each made to curve over the entire width of a sealing portion (see Japanese Unexamined Patent Publication No. H10-196535. This structure is

supposed to ensure that the beads are still allowed to become deformed readily even when the gasket has a large wall thickness.

However, the invention disclosed in Japanese Unexamined Patent Publication No. H11-343974 has a problem in that since the levels of pressure required to deform the beads (full beads) with the U-shaped section is relatively high, the desired effect cannot be achieved with ease in conjunction with a gasket with a significant wall thickness. For instance, if the gasket is also to function as a retainer for regulating the movement of a discharge valve, the wall thickness of the gasket needs to be increased to ensure a higher level of gasket strength. For this reason, it is difficult to provide a gasket with a retainer function in conjunction with the full beads, and the difficulty becomes more pronounced in a CO_2 cycle in which the discharge pressure reaches approximately 10 MPa.

In addition, while the beads disclosed in Japanese Unexamined Patent Publication No. H10-196535 are made to curve over a width greater than that of the full beads and thus the required level of flexure can be assured even when the gasket has a relatively large wall thickness, they are not ideal for improving the sealability and do not contribute to miniaturization of the compressor.

Accordingly, an object of the present invention is to provide a gasket used in a compressor, which contributes to both an improvement of the sealability and miniaturization of the compressor.

DISCLOSURE OF THE INVENTION

In order to achieve the object described above, the present invention provides a gasket for a compressor used in a compressor in which a fluid

is force-fed, having a raised portion that rises so as to surround a sealed portion and characterized in that the end of the raised portion on the inner edge side and a base surface of the gasket are not positioned on a single plane.

The raised portion according to the present invention can be referred to as a "half bead" as opposed to the "full bead" with the U-shaped section disclosed in patent reference literature 1 mentioned earlier. Namely, while the full bead in the related art rises from its base surface to the vertex of the U-shape and then makes a U-turn to the point the height of which is the same as the height of the base surface so as to set the end of the bead on the inner edge side substantially to the height of the base surface, the half bead according to the present invention has an end thereof at a point arising from the base surface to a predetermined height and thus at least part of the U-turn portion ranging from the vertex to the base surface in the related art is not included in the half bead. In the gasket according to the present invention structured as described above, the raised portion is allowed to contact at high pressure the area around the sealed portion such as a cylinder to assure high sealability. Furthermore, since the raised portion does not have the U-turn portion, the entire width of the gasket can be reduced to realize overall miniaturization of the compressor. In addition, since a desirable level of flexure is retained at the raised portion assuming the structure described above, the raised portion can be deformed readily even when the gasket has a large wall thickness.

It is desirable that the raised portion be constituted with a flat surface positioned at a height different from the height of the base surface

and an inclined surface linking the flat surface and the base surface with a predetermined angle of inclination.

In this case, the raised portion assumes a gently sloping shape or the shape of a shallow bowl. With such a gasket clamped at a specific position, the inclined surface becomes compressed and deformed to assume a flat shape which, in turn, causes the area where the inclined surface links with the base surface and the area where the inclined surface links with the flat surface to press against the sealed portion with a significant force, thereby assuring a high level of sealability. While the angle of inclination of the inclined surface should be adjusted as necessary in correspondence to the required level of sealability, the inclined surface should not be inclined at a right angle since the inclined surface needs to become deformed into a flat shape.

Also, if the gasket is disposed between a cylinder block and a valve plate, the inner edge of the flat surface of the raised portion surrounding a cylinder formed at the cylinder block should not form a circle.

Under normal circumstances, an intake valve, as well as the gasket, is clamped between the cylinder block and the valve plate. The raised portion should assume a noncircular shape according to the present invention as described above, mainly in consideration of the shape of the intake valve.

In addition, for structural and functional reasons, the outer edge of the flat surface should not assume a shape similar to the shape of the inner edge of the flat surface. It is desirable that the outer edge of the flat surface be in contact with the intake valve in its entirety and that only a specific portion of the inner edge of the flat surface be in contact with the

intake valve. The specific portion ideally is an area corresponding to a connecting base at which the lead portion of the intake valve is connected.

If the gasket is disposed between the valve plate and a cylinder head, a raised portion should be disposed at least at a location at which a high/low pressure barrier wall is sealed and a location at which an atmospheric pressure barrier wall is sealed.

The high/low pressure barrier wall separates a discharge chamber and an intake chamber both defined within the cylinder head from each other, whereas the atmospheric pressure barrier wall separates the inner space of the housing from the outside. A high level of sealability must be assured at the high/low pressure barrier wall and the atmospheric pressure barrier wall each separating two spaces with greatly differing pressures.

In addition, the full advantage of the raised portion can be yielded by forming the inclined surface so as to set it in contact with the high/low pressure barrier wall or the atmospheric pressure barrier wall.

It is also desirable that the gasket include a retainer portion for regulating the operation of a discharge valve.

A discharge valve is normally disposed adjacent to the gasket between the valve plate and the cylinder head, and the gasket having a retainer function will help reduce the number of required parts and simplify the structure. In particular, the gasket for a compressor according to the present invention sustains a desirable level of flexure at the raised portion and is thus fully functional even when the wall thickness is increased to assure the retainer function.

The gasket for a compressor according to the present invention assuring a high level of sealability and contributing to miniaturization is particularly ideal in applications in compressors used to force feed carbon dioxide under high-pressure conditions, the miniaturization of which is eagerly sought after.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of the structure of a compressor achieved in an embodiment of the present invention;

FIG. 2 is an enlarged sectional view of the structure of the member clamped between the cylinder block and the rear head (cylinder head);

FIG. 3 is a perspective of a structural example that may be adopted in the intake valve-side gasket in the embodiment;

FIG. 4 presents an enlarged top view and sectional view both showing the structure of a raised portion in the intake valve-side gasket;

FIG. 5 is a top view showing the relationship between the raised portion in the intake valve-side gasket and the intake valve in a partial enlargement;

FIG. 6 is a sectional view illustrating the advantage realized with the raised portion in the gasket according to the present invention in a partial enlargement;

FIG. 7 is a sectional view showing the structure adopted in the discharge valve-side gasket in the embodiment in a partial enlargement;

FIG. 8 presents a structural example that may be adopted in the rear head (cylinder head) in the embodiment in a top view illustrating the structures of the high/low pressure barrier wall and the atmospheric

pressure barrier wall; and

FIG. 9(a) is a sectional view taken at a 90° angle relative to the line A-A' in FIG. 7, showing the structure adopted in the area around the retainer portion in the embodiment in a partial enlargement and FIG. 9(b) illustrates the retainer effect achieved in the embodiment.

BEST MODE FOR CARRYING OUT THE INVENTION

An embodiment of the present invention is now explained in reference to the attached drawings. A compressor 1 in FIG. 1, which constitutes part of a supercritical vapor compressing refrigerating cycle (CO_2 cycle) in which carbon dioxide is used as the coolant, comprises a cylinder block 2, a front-side cylinder head (hereafter referred to as the front-head) 3, a rear-side cylinder head (hereafter referred to as the rear head) 4, a valve plate 5, intake valves 6, discharge valves 7, an intake valve-side gasket 10, a discharge valve-side gasket 11, a drive shaft 14, a swash plate mechanism 15, pistons 16, pins 20, 21 and the like.

A plurality of cylinders 25 are formed at the cylinder block 2, with a piston 16 slidably inserted at each cylinder 25. In addition, at the end of each cylinder 25 toward the rear head 4, an intake valve regulating portion 29 is formed, which regulates the opening operation of the intake valve 6. At the rear head 4, an intake chamber 27 and a discharge chamber 28 are defined so as to face opposite each cylinder 25. Inside the front had 3, a hollow crank case 30 is defined, with the swash plate mechanism 15 which includes a swash plate 32 and an angle-adjusting the mechanism 33 disposed inside the crank case 30. The drive shaft 14 is rotatably held by bearings and the like formed at the front head 3 and

the cylinder block 2 and is linked to the swash plate mechanism 15 so as to communicate a drive force to the swash plate mechanism 15.

As shown in FIG. 2, the intake valve-side gasket 10, the intake valve 6, the valve plate 5, the discharge valve 7 and the discharge valve-side gasket 11 are clamped between the cylinder block 2 and the rear head 4.

The intake valve-side gasket 10, which is disposed between the cylinder block 2 and the intake valve 6 (the valve plate 5), includes a base surface 30, raised portions 35 and through holes 42, as shown in FIGS. 2 through 4. FIG. 3 shows an example of a structure that may be adopted in an intake valve-side gasket 10 used in a compressor 1 having seven cylinders 25, with the raised portions 35 formed at specific positions so as to surround each cylinder 25.

The raised portions 35 each include a flat surface 40 and an inclined surface 41, with the flat surface 40 set at the position raised from the base surface 30 by a predetermined extent and ranging substantially parallel to the base surface 30. The inclined surface 41 achieving a specific angle of inclination links the flat surface 40 and the base surface 30. Consequently, an end 43 of the flat surface 40 and the base surface 30 are set at positions with differing heights.

In addition, an inner edge 44 of the flat surface 40 does not assume a circular shape and an outer edge 45 of the flat surface 40 does not have a shape similar to that of the inner edge 44 at the raised portion 35 in the intake valve-side gasket 10, as shown in FIG. 4, due to consideration for the shape of the intake valve 6 shown in FIG. 5. In addition, it is desirable to set the outer edge 45 in contact with the intake valve 6 over its entirety and to set only a specific portion 47 of the inner edge 44 in contact with

the connecting base of a lead portion 6a of the intake valve 6.

FIG. 6 shows a raised portion 35 in the intake valve-side gasket 10 clamped between the cylinder block 2 and an intake valve 6. As the gasket is clamped between the cylinder block and the intake valve, the rear side of the base surface 30 comes in contact with the cylinder block 2 and the flat surface 40 comes in contact with the intake valve 6 so as to flatten the inclined surface 41. As a result, a linking area 50 where the base surface 30 and the inclined surface 41 link with each other and a linking area 51 where the flat surface 40 and the inclined surface 41 link with each other become pressed with a significant force, thereby achieving a high level of sealability. In addition, since the raised portion 35 according to the present invention does not have a U-turn portion ranging from the vertex of the U-shape to the base surface present in the bead (full bead) with the U-shaped section in the related art, the absence of the U-turn portion allows the overall width of the gasket to be reduced. According to the present invention, full beads with, for instance, a width of 4 mm in the related art can be replaced with half beads with a width of 2 mm to reduce the external diameter of the compressor by 4 mm. Furthermore, a desirable level of flexure is sustained at the raised portions 35 according to the present invention, which allows the present invention to be adopted in an ideal manner even when the gasket has a significant wall thickness.

As shown in FIGS. 2 and 7, the discharge valve-side gasket 11 disposed between the valve plate 5 (a discharge valve 7) and the rear head 4 includes raised portions 60 and a retainer portion 65 as shown in FIGS. 2 and 7. The raised portions 60 each include a flat surface 61 and an inclined surface 62, and the raised portions 60 are disposed at a position

facing opposite a high/low pressure barrier wall 70 separating an intake chamber 27 from the corresponding discharge chamber 28 formed in the rear head 4 and an atmospheric pressure barrier wall 71 separating the space inside the discharge chamber 28 from the outside of the housing (the atmosphere) with the inclined surfaces 62 made to come in contact with the barrier walls 70 and 71.

FIG. 8 shows an example of a structure that may be adopted in the rear head 3 (the high/low pressure barrier wall 70 and the atmospheric pressure barrier wall 71) used in conjunction with a compressor 1 having seven cylinders 25. In this structural example, the raised portions 60 are disposed so as to surround the intake chambers 27 and discharge chambers 28 along the barrier walls 70 and 71. In addition, while the flat surfaces 61 and the inclined surfaces 62 basically adopt shape characteristics and functions identical to those of the flat surfaces 40 and the inclined surfaces 41 at the raised portions 35 in the intake valve-side gasket 6 described earlier, the inner edges of the flat surfaces 61, unlike the inner edges of the flat surfaces 40, do not need to assume a noncircular shape or the inner edges and the outer edges of the flat surfaces 61 do not need to be asymmetrical with respect to each other, as long as the flat surfaces 61 and inclined surfaces 62 achieve shapes matching those of the barrier walls 70 and 71.

The retainer portions 65 provided to regulate the valve opening operation of the discharge valves 7 are each formed by raising the discharge valve-side gasket 11 toward the discharge chamber 28, as shown in FIGS. 2 and 9(a). In addition, a retainer hold 72 is formed inside the discharge chambers 28 at the rear head 4. As shown in FIGS. 9(a) and

9(b), the retainer holds 72 are each formed so as to press against an area corresponding to a connecting base 75 of a lead portion 74 of the discharge valve 7.

The presence of the retainer holds 65 in the discharge valve-side gasket 11 contributes to a reduction in the number of required parts and further structural simplification. Furthermore, since a desired level of flexure is assured at the raised portions 60 in the gasket according to the present invention, the present invention can be adopted in an ideal manner even when the gasket has a large wall thickness in order to assure its retaining function.

It is to be noted that while the raised portion 35 in the intake valve-side gasket 10 rises toward the intake valve 6 and the raised portion 60 rises toward the rear head 4 in the discharge valve-side gasket 11, the gasket for a compressor according to the present invention is not limited to this example and all of or some of the raised portions 35 and 60 may be formed so as to rise toward the sides opposite from those in the structure described above. Namely, the raised portions 35 at the intake valve-side gasket 10 may rise toward the cylinder block 2 and the raised portion 60 at the discharge valve-side gasket 11 may rise toward the discharge valve 7 (valve plate).

INDUSTRIAL APPLICABILITY

According to the present invention, with the raised portions surrounding sealed portions formed as described above, a high level of sealability is assured and the compressor can be realized as a compact unit. In addition, even when the gasket has a larger wall thickness in

order to achieve a retainer function at the gasket, a desirable level of flexure is still maintained at the raised portions and thus, the present invention can be adopted in an ideal manner even when the gasket has a significant wall thickness.